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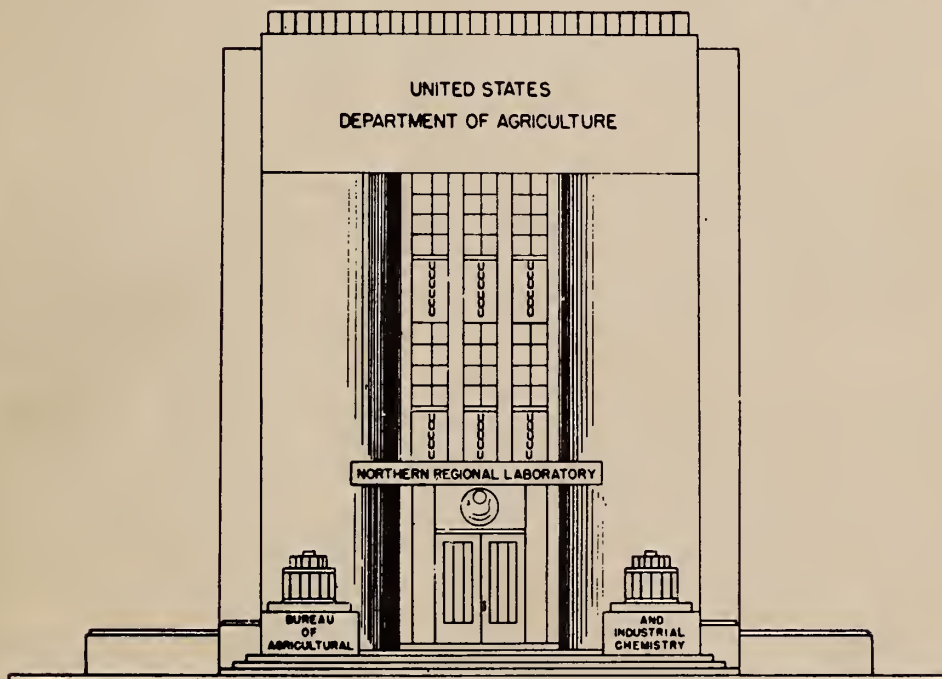


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SOYBEAN OR VEGETABLE MILK
Resume and Bibliography

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By

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SOYBEAN OR VEGETABLE MILK--RESUME AND BIBLIOGRAPHY*

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Soybean milk is an important food in China where it is commonly used as a hot breakfast drink (53). It is also used extensively throughout China as a baby food (see bibliography index) and is recommended by Ruhrah (4) and Sinclair (29) as a check on the very prevalent summer diarrhœa and intestinal disturbances among children.

Since the Japanese invasion of China, the vegetable milk has been used extensively for feeding babies and children in refugee camps. This use has afforded a unique opportunity for observation, on a relatively large scale, of the nutritional effects of soybean milk as a supplementary food. A group of the children who did not drink the milk served as a control in comparing its extra value in building body height and weight.

The observations were made in the refugee camps during 1937-39 by H. C. Hon, P. B. Mar, T. N. Read, and B. E. Read (119) of the Henry Lester Institute of Medical Research, Shanghai, and appeared in Special Report No. 12, published by the Chinese Medical Association. While the data collected and reported by these workers were incomplete in many respects, nevertheless the conclusions are significant, some of which appear in the summary of chapter IV, ". . . the results showed that children receiving soybean milk put on much more weight than those not receiving the soybean milk. Among control groups, children over one year old who received soybean milk also showed a somewhat greater monthly increase in height, although not so marked as the monthly increase in body weight."

Another important food product which is derived from soybean milk is "teou fu" (7,27,39,53,83). This is prepared by precipitating the protein from soybean milk with magnesium chloride, calcium sulfate or similar salts, or with acid, and by pressing the precipitated protein

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into cakes. The teou fu, or bean curd as it is also called, corresponds to the casein which is precipitated from cow's milk by souring or with the action of rennet; for this reason, the teou fu and fermentation products derived from it are sometimes referred to as soybean cheese. A complete description of the bean curd and its many modifications will be found in *The Soybean* (53) by Piper and Morse.

Yuba is another ancient oriental food which is prepared by removing and drying the protein film that forms on the surface of soybean milk when boiled. It is dried in the form of brittle sheets or sticks and is a popular food with both the Chinese and Japanese people.

Soybean milk as ordinarily produced does not have the bland flavor or smooth texture of cow's milk, and furthermore, its nutritive value has not been as scientifically evaluated as the latter milk. Nevertheless, its long and successful use in China and the available experimental data on its use in feeding children indicate that it has good nutritive properties. Soy milk is prepared successfully as a dry powder or as a condensed product and can be shipped long distances; it can also be prepared and used in tropical climates or densely populated countries where the milk cow cannot be maintained.

Even in the United States where animal milk has received the greatest recognition as a necessary food for both children and adults, the soy milk is being produced by several companies. One successful processor is unique in that he is using the vegetable type of bean rather than the field varieties in order to obtain a superior tasting product. In addition to its use as a beverage, the dry milk powder has considerable promise as an ingredient of pastry and bakery goods and as a component of prepared flours.

PREPARATION OF SOYBEAN MILK

An examination of the literature on soy milk reveals that there are many variations in its preparation. Either the whole bean or the full fat soy flour may be used in making this product, with about the same final results; if prepared from solvent-extracted soybeans, the milk would be lacking in fat. The following description will serve as a general outline of the process and will indicate some of the variations which have been patented or developed as improvements over the original method. The yellow-seeded varieties of beans are recommended for making soy milk.

The beans are washed several times with water to free them of dirt or other foreign matter and then soaked in water about 10 hours in summer, or as much as 24 hours in winter. The beans are ground to a mush with the addition of small amounts of water, and the mush is then extracted with water or a dilute alkaline salt solution so that the final ratio of milk to beans by weight will not be greater than 8:1. The insoluble residue is removed by means of a cloth filter or a centrifuge, and the milk is boiled for about 20 minutes.

In many of the processes described in the literature, sugar, salts, and fats are added to the extract to bring the concentration of these constituents to about the same value as that of cow milk. In some preparations, cumarine (53) vanillin, (51) and chocolate or malt (18,21) have been added to the milk to improve its flavor. Oil, rich in fat-soluble vitamins, is also used for enrichment in some of the modern preparations.

The composition of soy milk will have a relatively wide variation for several reasons. There are some marked variations in the composition of the different varieties of soybeans, but more important deviations will result from such factors which influence the extraction procedures as the fineness of grinding of the mash, ratio of the water or salt solution to the beans, and the temperature of extraction. The addition of oil or fat, sugar, salt, and flavoring materials may be the cause, however, of the greatest variation in the milk's composition.

A compilation of data from various sources on the composition of soy milk was made by Piper and Morse (53). These data along with the composition of cow milk are given in the following table.

Composition of Soybean Milk Compared with Cow's Milk

Kind of Milk	: Water	: Protein	: Fat	: Carbohy- : drate	: Other : sub- : stances	: Ash	: Total : Solids	: Solids : not : fat
	: Percent	: Percent	: Percent	: Percent	: Percent	: Percent	: Percent	: Percent
Soybean	: 92.00	3.70	2.00	1.80		0.50	8.00	6.00
Soybean	: 90.00	4.95	2.97	1.34		0.44	9.70	6.73
Soybean	: 89.25	3.15	3.10	3.02	1.02	0.45	10.74	7.64
Soybean	: 92.50	3.02	2.13	0.03	1.88	0.41	7.47	5.34
Cow's Milk	: 87.30	3.42	3.67	4.78		0.73	12.60	8.93

The pH of soy milk as determined in this Laboratory is 6.6 to 6.7; when the milk is allowed to sour in a normal way, the pH will drop to about 4.9 and cause precipitation of most of the protein.

From the literature, the authors have selected examples illustrating a few specific variations in the preparation of soy milk which will influence its taste, texture, and composition.

Fritz G^ussel (11,12,15) prefers extracting the ground beans with a hot solution of phosphate. After filtering out the insoluble part of the mash, he adds milk sugar, salt, sodium carbonate or bicarbonate, and a choice of coconut oil, sesame oil, or pistachio nut oil, and, finally, a suitable flavoring material.

1/ Food and Food Products, edited by Morris B. Jacobs.

Monahan and Pope (21) prepare a dry milk powder and emphasize the use of malt, chocolate, or cocoa as a flavoring ingredient. Melhuish (23) modifies the process by removing the soybean oil, which he claims has an undesirable flavor, and by replacing it with sesame oil and acids like butyric acid. He also recommends (35) combining the peanut with the soybean to improve the flavor of the milk powder.

Richards (55) dries and toasts the residue from the milk preparation and recommends it as a breakfast food. Kellogg (91) sterilizes soybean milk and then inoculates it with Bacillus acidophilus to produce a "buttermilk" type of product.

The following classification of the bibliography will indicate the wide interest in soy milk and assist in finding information on various phases of the subject.

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